Combined Lateral Corpectomy with Posterior Instrumented Fusion for the Management of Post-Infectious Kyphosis

David P. Falk, MD[1]
Srish Chenna[2]
Steven Zhang, MD[1]
Stephen R. Barchick, MD[1]
Amrit S. Khalsa, MD[1]
David S. Casper, MD[1]

[1]Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, PA

[2]School of Engineering and Applied Sciences, University of Pennsylvania, Philadelphia, PA

Abstract

Although many surgical approaches have been described in the operative management of osteodiscitis, there is no consensus optimal technique. We present two patients who developed post-infectious kyphosis and were treated using combined lateral corpectomy with an expandable cage and posterior instrumented fusion. These cases highlight the utility of the lateral retroperitoneal approach in addressing post-infectious kyphosis.

Introduction

In recent years the incidence of spinal infections has been on the rise[1]. This finding has been attributed to improved diagnostic techniques as well as an increase in surgical volume[1]. Today, the most common form of spine infection in individuals over 50 years of age is bacterial infection of the intervertebral disc and adjacent vertebrae, known as osteodiscitis[2–4].

The disease process is characterized by deposition of bacteria from the bloodstream into the relatively avascular intervertebral disc[5]. The poor local vascularity of the intervertebral disc allows for bacterial proliferation, which can lead to invasion of adjacent structures and destruction of the vertebral endplates. Progressive destruction can culminate in spinal instability, deformity, abscess, and spinal cord compression[1].

The treatment of vertebral osteodiscitis is dependent upon the degree to which the infection. Antimicrobial therapy is fundamental to managing this condition and remains the first-line treatment. Indications for surgical intervention include progressive neurologic deficits, progressive deformity, instability, or persistent infection despite appropriate antimicrobial therapy[5,6].

When surgery is indicated, the decision regarding approach or technique is dictated broadly by the presence of deficits, the location of the infection within the spinal column, as well as the amount of bony destruction and deformity[1]. For patients with significant anterior and middle column destruction, anterior column reconstruction is often warranted[1,7].

Although anterior and posterior approaches are well-described in the literature in the surgical management of osteodiscitis, recently other techniques have utilized a lateral retroperitoneal approach. These include standalone lateral fusion with a plate as well as lateral reconstruction combined with posterior pedicle screw fixation[7–9].

(Turn this back to what it was originally please)

A combined lateral corpectomy with an expandable cage supplemented with posterior instrumented fusion can be utilized for the management of post-infectious kyphosis, as seen in these two cases.

Case 1:

A 61-year-old male with a past medical history significant for untreated Hepatitis C and cocaine-use disorder presented to the emergency room with one week of severe, progressive low back and bilateral lower extremity pain. His physical examination was notable for bilateral weakness in hip flexion. Radiographic and Magnetic Resonance Imaging (MRI) demonstrated a ventral epidural abscess at L3-4 with vertebral osteodiscitis extending from L3-L5 (Figures 1A & 1B).

Surgery

He underwent urgent operative L3-L5 laminectomy and decompression of the abscess. Operative cultures were negative, though blood cultures and urine cultures grew *E. Coli*. The patient's symptoms resolved post-operatively and he was discharged on post-operative day (POD) six with a peripherally inserted central catheter (PICC) line to complete a six-week course of targeted antibiotic therapy.

Despite initial improvements, he returned to clinic on POD 19 noting recurrence of low back and bilateral lower extremity pain with stable motor and sensory exam. Standing radiographs revealed interval collapse at L3-4 with focal kyphosis (Figure 1C).

The patient was brought to the operating room for a right-sided retroperitoneal approach

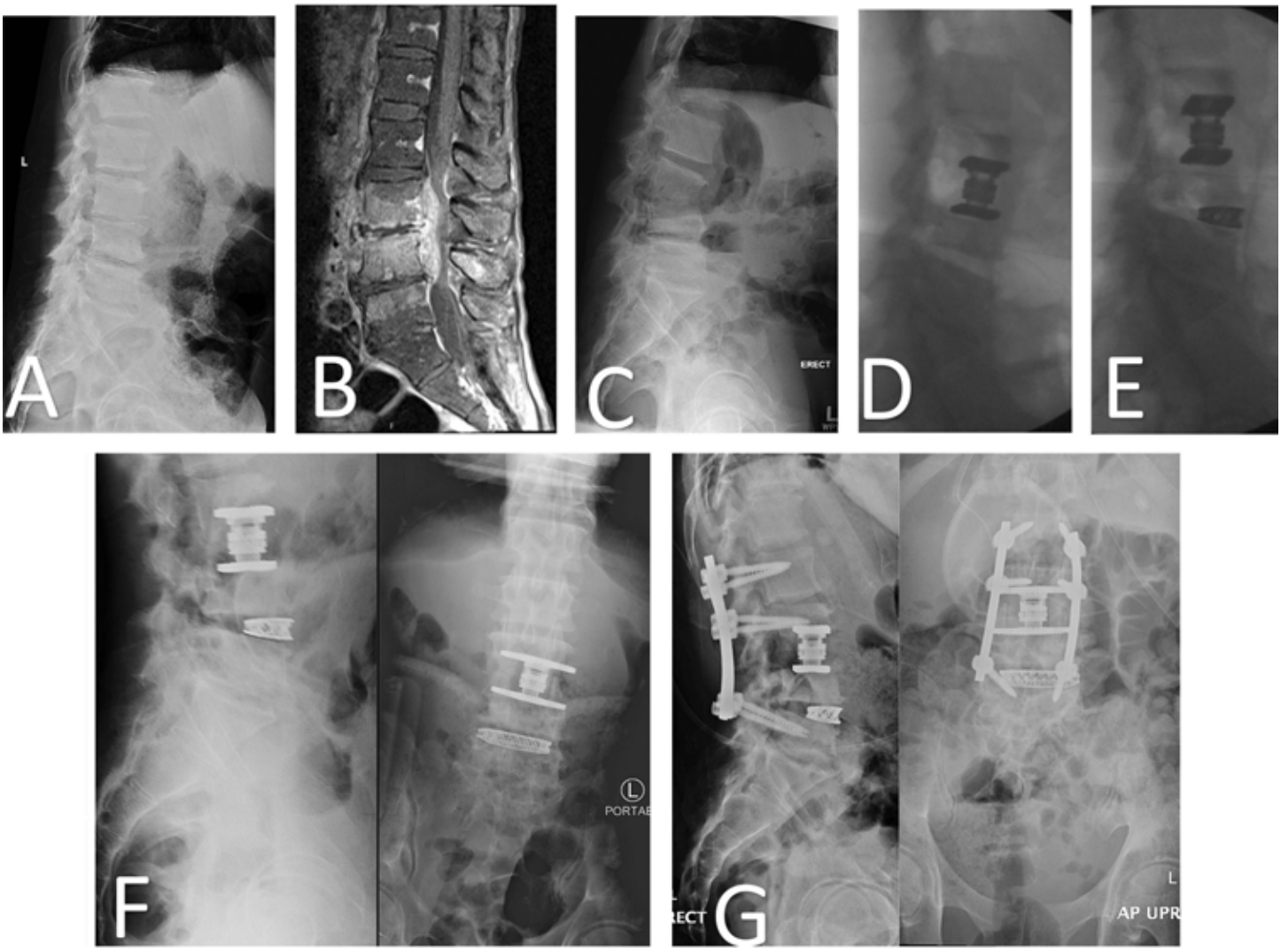

Figure 1A. Lateral radiograph of the lumbar spine showing loss of lordosis with multi-level degenerative changes. Endplate erosive changes are seen at L3-4 & L4-5.
Figure 1B. Sagittal T1 Contrast-Enhanced MRI demonstrating marrow and disc edema extending from L3-L5, in association with a large ventral epidural collection.
Figure 1C. Lateral radiograph of the lumbar spine illustrates the interval development of a focal kyphotic deformity at L3-4.
Figure 1D. Intra-operative lateral fluoroscopic image of the lumbar spine showing improvement in lumbar lordosis following insertion of the expandable interbody cage at L3-4.
Figure 1E. Intra-operative lateral fluoroscopic image of the lumbar spine following placement of an interbody cage at L4-5.
Figure 1F. Intra-operative lateral and AP radiographs of the lumbar spine demonstrating restoration of lumbar lordosis with an expandable interbody cage at L3/4 and an interbody cage at L4-5.
Figure 1G. Post-operative standing lateral and AP radiographs of the lumbar spine showing the final construct with posterior instrumentation L2-L5.

to the lumbar spine. Utilizing large osteotomes under fluoroscopy, a partial corpectomy of the L3 and L4 vertebral bodies was performed to debride residual infectious and necrotic tissue, followed by insertion of a large footprint expandable interbody cage packed with cancellous iliac crest autograft. The cage was expanded to restore native vertebral height and lordosis (Figure 1D). After, a complete lateral discectomy was performed through the same incision at L4-5 followed by insertion of an interbody cage packed with iliac crest autograft (Figures 1E & 1F). these incision were closed after completion of this portion of the procedure.

Next, the patient was repositioned prone and instrumented with bilateral pedicle fixation at L2, L3, and L5, skipping L4 due to the partial corpectomy. Cobalt chromium rods were then utilized to secure the segment.

Post-operative Period

Initially, the patient was managed in the intensive care unit (ICU) post-operatively. He was transferred to the floor on POD 2. He remained neurologically stable. Standing radiographs were obtained (Figure 1G).

The patient was discharged on POD ± to complete a 6-week course of additional targeted treatment guided by the infectious disease team. He returned to clinic on POD 39, reporting complete resolution of his pre-operative pain. Unfortunately, the patient was lost to follow up.

Case 2:

A 69-year-old male with a past medical history significant for tonsillar squamous cell carcinoma, intravenous (IV) drug use, hypertension, and a remote history of L1-2 osteomyelitis

treated with IV antibiotics presented to our clinic with progressively worsening low back pain and forward bent posture. His physical examination was notable only for a focal, tender prominence posteriorly over L1-2. Standing lateral thoracolumbar radiographs and CT scan demonstrated focal kyphosis at L1-2 with significant sagittal imbalance (Figures 2A & 2B). Given his progressive kyphosis with a history of infection with severe back pain and sagittal imbalance, he was indicated for reconstruction with a combined lateral corpectomy and posterior instrumented fusion.

Surgery

The patient was positioned in the left lateral decubitus position, The L1-2 disc space was localized fluoroscopically. The T10 rib was partially resected with attention to preserving the neurovascular bundle. The retropleural space was traversed carefully to gain access to the lateral vertebral bodies of L1 and L2. Retractors were positioned to allow complete discectomies at the T12-L1 and L2-3 disc spaces under fluoroscopic guidance. After, a corpectomy was performed at the L1 and L2 levels using large osteotomes. Then a large footprint expandable cage with local rib autograft was inserted to recreate native height and restore alignment. A lateral plate spanning T12-L3 was placed for additional fixation (Figure 2C). The incision was closed to allow for repositioning.

The patient was repositioned prone to allow a standard posterior midline approach. Bicortical pedicle screw fixation were placed from T11-L3 spanning the defect. A partial laminectomy and posterior column osteotomy at L1-L2 with instrumented fusion followed.

Post-operative Period

Post-operatively, the patient was managed in the ICU and transferred to the floor on POD3. He remained neurologically intact. Standing radiographs were obtained (Figure 2D). Operative cultures remained no growth and the patient was discharged on POD 6.

At his last follow up on post-operative day 57, the patient reported improvement in pain along with symptomatic improvement in his standing alignment. Physical exam remained stable. Standing AP and lateral radiographs of the lumbar spine demonstrated well aligned hardware with no evidence of subsidence.

Discussion

Although osteodiscitis is managed conservatively with intravenous antibiotics as a first-line treatment, patients with progressive neurologic deficits, progressive deformity, instability, and/or persistent infection should undergo operative intervention[5,6]. Despite the relative consensus on operative indications for refractory cases, the optimal surgical technique remains controversial. Multiple approaches have been described, including stand-alone anterior lumbar interbody fusion (ALIF), ALIF with posterior stabilization, and all-posterior constructs[7].

While high rates of infection clearance and fusion have been reported with these techniques, there are several challenges to consider with both anterior and posterior approaches[10]. The anterior approach inherently requires mobilization of the great vessels, often requiring additional resurce staffing with an access surgeon, which exposes patients to potential vascular complications and requires additional personnel to

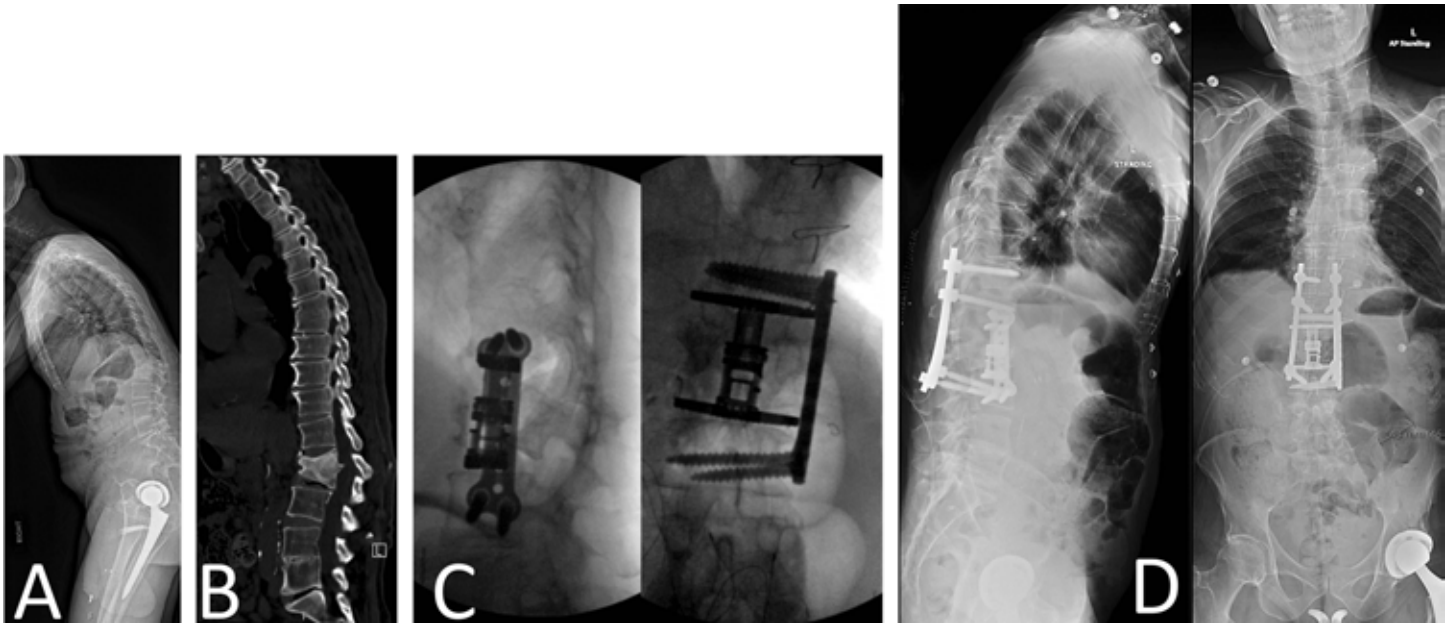

Figure 2A. Standing lateral thoracolumbar radiograph showing sagittal imbalance with severe anterior wedge compression deformity at L1-2 with focal kyphosis osseous fusion of the vertebral bodies

Figure 2B. Sagittal CT scan of the thoracolumbar spine further illustrating the compression deformity and fusion at L1-2 with focal kyphosis. Autofusion of L4/5 is noted as well.

Figure 2C. Intra-operative lateral and AP fluoroscopic images of the thoracolumbar spine demonstrating improvement in lordosis following insertion of the expandable interbody cage. The lateral plate with screws into T12 and L3 is also visualized.

Figure 2D. Post-operative standing lateral and AP radiographs of the lumbar spine showing the final construct, including the posterior fixation from T11-L3.

complete the surgical procedure. the possibility of vascular insult is relevant particularly in patients with osteodiscitis, as vascular adhesions are a concern in the setting of prior or active infection. Additionally, there are cardiopulmonary concerns with anterior exposure in the thoracic spine, and obesity can also limit ease of exposure with the anterior approach in general[7].

With a posterior approach, surgeons can decompress the spinal canal directly. However, adequate exposure of the affected intervertebral disc and vertebral bodies can be difficult with anatomic constraints limiting cage size for anterior column support[9]. Moreover, the posterior approach requires a laminectomy, which may destabilize a spine further. Given the disease process has already destroyed the anterior and middle columns, a laminectomy puts the remaining posterior column in a precarious situation.

Given these considerations with anterior and posterior approaches, some surgeons are utilizing the direct lateral retroperitoneal approach in the treatment of osteodiscitis, both as a standalone technique and with posterior supplemental fixation[7-9]. The lateral retroperitoneal approach is well-described and is used to treat a wide variety of conditions affecting the lumbar spine. Often, this approach can be extended into the retropleural space for access to thoracic and thoracolumbar junctional pathology.

In the setting of osteodiscitis with or without kyphosis, a direct lateral retroperitoneal approach has several advantages in comparison to the anterior and posterior approaches used to treat the same condition. Preservation of the anterior and posterior longitudinal ligaments affords stability while ligamentotaxis can provide indirect decompression of the spinal canal and neuroforamen. Ease of exposure with modern retractor systems provide a relatively facile and minimally invasive approach . Finally, large footprint cages can be inserted through the same lateral corridor, resulting in lower subsidence, more powerful anterior column support and correction than is possible through a posterior-only approach, while also mitigating the vascular and intra-abdominal risks associated with an anterior exposure[9].

Conclusion

Given the challenges associated with creating a randomized trial comparing the surgical techniques used in the treatment of osteodiscitis, case series have become the primary tool in the literature to explore techniques and their results.

These are two cases of patients with osteodiscitis who developed post-infectious kyphosis both treated with a direct lateral retroperitoneal approach. Although the first patient developed a kyphotic deformity acutely and the second patient's deformity developed over a period of years, both were treated with combined lateral corpectomy with an expandable cage and posterior instrumented fusion. These cases add to the limited literature describing the direct lateral approach in the surgical treatment of post-infectious kyphosis and demonstrate its advantages compared to well-recognized anterior and posterior techniques.

References

1. Duarte RM, Vaccaro AR. Spinal infection: state of the art and management algorithm. *Eur Spine J.* 22 (2013) 2787–2799.

2. Grammatico L, Baron S, Rusch E, *et al.* Epidemiology of vertebral osteomyelitis (VO) in France: analysis of hospital-discharge data 2002–2003, *Epidemiol. Infect.* 136 (2008) 653–660.

3. Nabizadeh N, Crawford CH, Glassman SD, *et al.* Severity and Outcome of Neurologic Deficits in Patients with Pyogenic Spondylodiscitis: A Systematic Review, *Orthop. Clin. North Am.* 53 (2022) 105–112.

4. Khan IA, Vaccaro AR, Zlotolow DA, Management of vertebral diskitis and osteomyelitis, *Orthopedics.* 22 (1999) 758–765.

5. Taylor DG, Buchholz AL, Sure DR, *et al.* Presentation and Outcomes After Medical and Surgical Treatment Versus Medical Treatment Alone of Spontaneous Infectious Spondylodiscitis: A Systematic Literature Review and Meta-Analysis, *Glob. Spine J.* 8 (2018) 49S-58S.

6. Berbari EF, Kanj SS, T.J. Kowalski TJ, *et al.* 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults, *Clin. Infect. Dis.* 61 (2015) e26–e46.

7. Blizzard DJ, Hills CP, Isaacs RE, *et al.* Extreme lateral interbody fusion with posterior instrumentation for spondylodiscitis, *J. Clin. Neurosci.* 22 (2015) 1758–1761.

8. Patel NB, Dodd ZH, Voorhies J, *et al.* Minimally invasive lateral transpsoas approach for spinal discitis and osteomyelitis, *J. Clin. Neurosci.* 22 (2015) 1753–1757.

9. Timothy J, Pal D, Akhunbay-Fudge C, *et al.* Extreme lateral interbody fusion (XLIF) as a treatment for acute spondylodiscitis: Leeds spinal unit experience, *J. Clin. Neurosci.* 59 (2019) 213–217.

10. Ha KY, Shin JH, Kim KW, *et al.* The fate of anterior autogenous bone graft after anterior radical surgery with or without posterior instrumentation in the treatment of pyogenic lumbar spondylodiscitis, *Spine (Phila. Pa. 1976).* 32 (2007) 1856–1864.